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NASA TECH BRIEF

Stereo TV Enhancement Study

The problem:

To determine the effectiveness of stereo TV presentations in allowing an operator to remotely control an extra-terrestrial vehicle.

The solution:

Set up an artificial situation using photographs of lunar-type terrain on a dual TV-type projection system.

How it's done:

The first consideration was given to designing a background with no man-made objects from which size and distance could be judged. The site selected was the floor of an abandoned gravel pit, approximately 500 ft in diameter, surrounded by high banks, nearly vertical, and ranging in height from 20 to 30 ft. The floor was relatively level and consisted of sand and gravel ranging in size from very fine sand to rocks approximately 12 inches in diameter.

Since 35 mm slides were to be used in this project, another problem had to be considered: There is no atmosphere on the moon; therefore, there is no scattering of skylight, and shadows will tend to be darker than on earth. In order to compensate for this disparity, the negatives were underexposed. Also, the lunar albedo is low and even highlights would not be too bright. This was controlled in printing by using high-contrast film and slightly overexposing the final positive from the underexposed negative.

Twelve cones were made with an apex angle of approximately 30 degrees; the heights of these cones were (2 each) 4,6,10,16,26, and 40 in. The six different sizes were arranged in ascending order to form a geometric progression with a common ratio of 1.5.

Two cameras were mounted on a tripod with a sliding mount which could be adjusted to change the distance between cameras from 4 to 15 in. Certain parameters were held constant in all photographs; the cameras' height above the terrain was held at 41 in.; they were tilted down about 8°, and a point on the ground 6 ft. from the cameras was always represented by the bottom of the picture. In order to give the photographs a stereo effect, half of the pictures were taken with the centers of the camera lenses 4 in. apart and the other half 12 in. apart. All photographs contained only two targets. The cameras were set at various angles in relation to each other and the distance between them varied from 2 to 20 ft.

There are ten well known cues in distance judgment. Two of these cues depend on the use of two eyes; the other eight are monocular (works as well with one eye as with two). First of the eight monocular cues is the estimation of distance by the angle subtended by an object of known size. This cue also works in reverse so that if the distance of an object is known, the size may be estimated. Other monocular cues are: a) aerial perspective; b) linear perspective; c) lights and shadows; d) overlapping contours; e) motion parallax; f) accommodation; and g) association.

A noise level of 5snr was chosen because it closely resembles noise seen on commercial television during periods of severe atmospheric disturbances. Results of the noise study indicated that: a) there was an increase in noise causing a reduction in number of targets seen; b) there was no change in the accuracy with which cone size is judged; c) there was a steady, and marked, improvement in the mean absolute error of the distance-to-judgments as noise increases; and d) there was an equally steady, but not as marked, improvement in the mean absolute error of the judgments of distance between targets as the noise increases.

(continued overleaf)

Note:

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